THE FORM BOARD TEST

SEP 11 1914

BY

REUEL HULL SYLVESTER

A thesis presented to the Faculty of the Graduate School of the University of Pennsylvania in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

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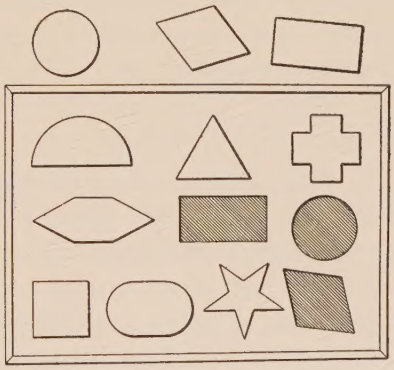
I

DESCRIPTIVE AND HISTORICAL SKETCH

The form board has been used for several years, and clinical psychologists continue to regard it as one of their best general tests. It appeals to the child's interest, affording him a short and fascinating task which calls for his best effort, and it helps to free him from the fear and self-consciousness which often interfere seriously in a mental examination. At the same time the test gives the examiner a good general view of the child's mentality and it usually indicates more or less clearly the nature of his defects.



THE FORM BOARD.—The forms are designated by numbers as follows: 1. Semi-circle. 2. Triangle. 3. Cross. 4. Elongated hexagon. 5. Oblong. 6. Circle. 7. Square. 8. Flattened oval. 9. Star. 0. Lozenge.

The form board is shown in the above figure. The ten geometrical figures, as nearly uniform in size as their variety of form will allow, are cut through an oak board 20 x 14 x ⅜ inches. This oak board is glued to a soft wood board of the same length and breadth, ⅝ inches thick. The result is a thick board of moderate weight with a hard oak surface in which the ten forms appear as shallow holes or recesses. About the edge is placed

an oak strip, 1¼ x ¼ inches, fitting flush with the soft wood back and forming a ¼ inch raised edge about the oak surface. Corresponding to the ten recesses are ten walnut blocks, ⅞ inch in thickness, each of which fits loosely into its corresponding recess. The thickness being more than twice the depth of the recesses the blocks can easily be grasped and removed. The board and the blocks are finished in their natural oak and walnut colors and the recesses are painted black. The whole is carefully finished in order to give it an attractive appearance,—an important feature in a mental testing device. This description applies to what may be called the standard form board,—the type now in most general use.

History of the Form Board

The first form boards were contrived for training purposes. Itard in his efforts to train the Wild Boy of Aveyron used as one of his devices a board two feet square upon which were pasted three pieces of brightly colored paper,—a red circle, a blue triangle, and a black square. Pieces of card board of the same forms and colors were to be matched with these by the boy. Other boards with various forms and colors were also used.[1]

Seguin constructed a number of form boards. Copies of some of them are still used at the Seguin School. One consists of an inch board about one foot square into the surface of which are cut four circular recesses a half inch deep and varying between an inch and three inches in diameter. Corresponding to these are four circular blocks one inch thick. Board and blocks are soft wood and are not stained or painted. Another Seguin board is of hard wood, is considerably larger than the kind just described and has a dozen variously shaped symmetrical forms. In a third kind the blocks are of light colored wood on one side and of dark colored wood on the other. The only form boards that Seguin himself made and used are in use at the Massachusetts Institution for the Feeble-Minded at Waverly. They are about two feet long and less than half as wide. The

[1] Des Premiers Developments du Jeune Sauvage de L'Aveyron, p. 41.

six recesses in each are arranged in a line. Boards and blocks are all of the same wood and color. Seguin conceived of a series of form boards graded as to difficulty and he had such a series planned and partly constructed.

Bourneville recommended light form boards or trays[2] very like those used by Dr. Maria Montessori. Montessori is the first to apply form board devices to the training of normal children.[3]

The form board was first used as a testing device by Dr. Naomi Norsworthy. In her study of mental defectives[4] she used as one of the tests a form board that had been constructed for practice curve studies by Dr. Joseph Hershey Bair.[5] This board was smaller than the standard form board already described, its blocks were provided with handles, and instead of the star and the cross it had a hexagon and an octagon.

Dr. Henry H. Goddard increased the board to its present size, substituted the star and the cross, arranged the forms more compactly, reduced them to such sizes and proportions that no block could be set into a recess not its own, and dispensed with the handles.

Professor Edwin B. Twitmyer adopted Goddard's arrangement and size of forms, but reversed their order, made the recesses shallower, used hard wood, contrasted the colors of board, blocks, and recesses, added the raised strip to the edge, and gave the whole a more attractive appearance. This is the kind of form board that was used in the present investigation.[6]

Methods of Giving the Test

Dr. Clara H. Town regards form perception as the primary feature of the test and so uses the number of *errors*[7] as the index

[2] Assistance des Enfants Idiots et Dégénérés, p. 233. Recherches Cliniques et Thérapeutuques, vol. XXIV, p. xxv.

[3] The Montessori Method (Tr. by Anne George), pp. 195 ff.

[4] The Psychology of Mentally Deficient Children, pp. 25, 26.

[5] The Practice Curve, p. 34.

[6] Robert S. Woodworth (Science, n.s. XXXI:171), and William Healy and Grace M. Fernald (Tests for Practical Mental Classification), have constructed and used other good form boards.

[7] By an *error* is meant an attempt to fit a block into a recess not its own.

of a child's form board ability. She takes a record of the number of errors made in each *trial*[8] until the trial in which all of the blocks are replaced without error, or until she is convinced that the child cannot replace them. In addition she notes the rapidity of the work and certain other features, but her procedure is planned to give greatest prominence to errors.

Goddard considers the amount of *time* required by the child for replacing the blocks as of prime importance. He gives three trials, and takes the time of the shortest of the three as the child's form board index. He also takes a record of the handling of the blocks and attaches some importance to the number of errors.[9]

Professor Lightner Witmer is most interested in the child's first attempts at the task. His procedure varies for different children, but he usually places the board before the child with no explanation except a mere statement as, "Let us see whether you can do this", or "Put the blocks in". Then he watches closely to catch the child's first reactions and to see how he attacks this new kind of problem. Successive trials are usually given and the method varied, the procedure depending on the way that the child reacts and the particular features of his mentality on which the examiner desires more light. If the child takes the usual interest in the task, he is often allowed to continue it while details quite apart from the general purpose of the test are studied. For instance after the blocks are in place the examiner may say in a low tone, "Now take them out", thus getting at the child's word-hearing ability. The record of the test as kept by Witmer usually consists of observations dictated while the test is being given.

These three methods are distinguished because they emphasize three different features of the form board test; errors, time, and reaction to a new task. In each some attention is given to the features emphasized in the others, so they are not entirely distinct. Other methods are modifications of these three.

[8] By a *trial* is meant the taking of all of the blocks from a pile and putting them into their recesses.

[9] Training School, IX, 49-52.

II

PRELIMINARY STUDIES

The purpose of the investigation reported in this monograph was to analyze certain features of the form board test psychologically, to determine upon the best method of applying it, and to work out a standard interpretation of its results. A long series of preliminary studies was necessary. Following a year's observation of the test in the Psychological Clinic of the University of Pennsylvania the investigator applied it to some four hundred children and several dozen adults, using various modifications of the three methods mentioned in the preceding section. Interviews with Goddard, Town, Woodworth, Wallin, Mrs. Seguin, and others who have used the test extensively, and conferences with the professors of psychology under whose direction the main investigation was to be carried on made possible a full and satisfactory interpretation of the results. These preliminary studies, besides giving a general orientation and opening up the various lines which would have to be followed out, yielded conclusions on three points which had to be decided tentatively before the investigation could proceed.

Position of Child, Board, and Blocks

The first of these conclusions has to do with the position of the child, the board, and the blocks at the beginning of a trial. The following arrangement was worked out. It was used throughout the later studies and proved to be entirely satisfactory. The form board lies horizontally on a table, its lower edge[1] even with the edge of the table next to which the child stands. The table must be low enough so that he can lean well over the board and look down upon the center of it. Children readily adapt themselves to height within a reasonable range, so an adjustable table is not necessary. One of ordinary height and a kindergarten table suffice, most children under nine years

[1] The lower edge is the edge next to the star recess.

of age requiring the latter. If the table is too high, the child has to look across the board instead of down upon it and he cannot see the forms so well;—an important point that is often neglected, many examiners having the board entirely too high for the child. The blocks should be placed in three piles on the table, next to the edge of the board on the side opposite the child, no block being in the pile nearest its own recess. If the child is in a position that enables him to look down upon the center of the board, he can easily reach the blocks piled in that way. Placing them at the right of the board as is often done, is of no advantage, and in that position they cannot be picked up with the left hand. Placing some at each end of the board is still worse for it offers the most possibilities for varying the difficulties of handling them.

Kind of Form Board to be Used

The second conclusion referred to the size of the board and the order of arrangement of the forms upon it. Some have suggested that the blocks of the standard form board are too large for small children. To test this a two-thirds sized model of the standard board was constructed. This board was tried with 15 six year old children, 28 five year olds, 18 four year olds, and 8 three year olds. Each child had two trials with the standard form board and two with the small one, half of each age taking them in the order, standard-small-standard-small and the other half taking them in the reverse order. The time required for placing the blocks was found to be practically the same for the two boards. The small board has a slight advantage in that small children can reach the extreme corner recesses more easily, but this is perhaps more than offset by the finer co-ordination required for fitting the small blocks into place. The small star was very difficult for the clumsy fingered little folk. The investigator and others who observed the work agreed that the regular sized blocks were grasped and handled with more certainty than the small ones. It was not thought worth while to try a larger board for it was evident that small children would

have difficulty in reaching its corner recesses. The question of re-arranging the forms on the board and of substituting other forms was also taken up. A board on which forms could be set in any order and turned at any angle was planned, but after experimenting with cardboard models it was decided that such a study would involve more than the present investigation should undertake; and further that the study of these details would probably contribute little to the efficiency of the device. It is obvious that the value of a test like this depends less on fine details of devices than on the method of using them and the interpretation of their results. It was therefore decided to proceed with the investigation using the standard form board.

Preliminary Consideration of Method

The third point which had to be decided tentatively before the investigation could proceed was as to which of the three methods should be the basis of the one used. Witmer's method, because it leaves the examiner free to fit the procedure to each individual case, brings out features of the child's mentality which the other methods cannot. But it is not adaptable to a quantitative study of groups of children such as was contemplated, and its results cannot be readily reduced to standards for comparing and ranking individuals. Town's method is more truly a form perception test than the others, but preliminary studies showed that normal children make so few errors that their records promise little in the way of norms and standards.[2] Goddard's method prescribes a definite procedure which partly prevents getting the most out of the first trial, but it gives quantitative results and makes possible the establishment of norms and standards. For this reason it was unquestionably the method to serve as the basis of the intended investigation.

Number of Trials to be Given

After these first preliminaries had been completed attention was given to a feature of Goddard's method which seemed to call for testing before being adopted, namely, the giving of three

[2] See chart III (page 36), and page 51.

trials. At the beginning it was necessary to set age limits for the children to be tested. Records had been kept of the 400 children and a number of others of children from three to seven years of age were now added. The results showed that an occasional four year old child could not place all of the blocks unless given assistance other than urging. So five years was set as the minimum age for the establishment of standards. Fourteen years was set as the maximum age because the form board is certainly of little value for testing individuals who have the ability of that age or of a year or two younger. The question of the number of trials was taken up by testing 200 children, 20 of each age from five to fourteen inclusive. Each child was given five trials at placing the blocks and the time of each trial was recorded. The results arranged in two year groups are given in tables I, II, and III. According to table I there is a

Trial	Age 5-6	7-8	9-10	11-12	13-14	Average
I	45	29	22	18	15	25.8
II	34	24	18	16	14	21.1
III	31	23	17	15	13	19.6
IV	30	21	18	14	13	19.2
V	30	22	17	13	12	18.9

Table I.—Average time in seconds for each of five trials. The data are from the records of 20 children of each age from five to fourteen.

Trial	Age 5-6	7-8	9-10	11.12	13-14	Average
I	13.8	5.5	5.1	4.7	2.6	6.3
II	11.0	5.2	3.4	2.8	3.0	5.1
III	9.5	3.5	3.2	2.5	2.3	4.2
IV	7.8	3.8	3.1	2.5	2.1	3.9
V	7.6	3.1	3.3	2.4	2.2	3.7

Table II.—Standard deviations for the data of table I.

Trial	Age 5-6	7-8	9.10	11.12	13-14	Total
I	1	0	2	1	2	6
II	8	9	9	8	6	40
III	11	12	14	10	12	59
IV	13	11	13	19	12	68
V	14	17	19	20	18	88

Table III.—Number of individuals making their shortest record on the first trial, on the second trial, etc. for the five trials. Data of table I. Where the shortest record was made on two different trials each is credited with it.

general decrease in the length of time records of successive trials, the average falling from 25.8 seconds for the first trial to 19.6 seconds for the third trial. Each age group shows the decrease regularly for the first three trials. The decrease for the fourth and the fifth trials is not so marked, the time averages being 19.2 seconds and 18.9 seconds respectively, and in some of the groups the decrease is not regular. Variability (Standard deviations, table II) also shows a decrease with successive trials, the averages of the five in order being 6.3, 5.1, 4.2, 3.9, and 3.7 seconds. Here also the decrease is greatest in the first three trials and the age groups show regular decreases except in the fourth and fifth. Table III indicates that practice is a very important factor, most of the shortest records being made after the second trial, and a larger number on the fifth trial than on any other. This evidence has less weight when considered in the light of the small average time decreases for the fourth and the fifth trials as has been noted in table I, for with such small average decreases, it must have been that in a great number of cases the last trials were shortest by only a second or two. These three tables indicate that in general the first trial is the most irregular in every way and so is the least reliable. Likewise the fifth trial is the most reliable, and of the five trials each is more reliable than those preceding it. The third trial is so much more consistent than the first and the second that the necessity of giving at least three trials is obvious. But the differences between the third, fourth, and fifth are comparatively small and as will be shown farther on, a difference of a second or two in indices is of little consequence. It is evident then that the demands for brevity and convenience in a test like this more than offset the small gain in accuracy that would be made by giving a fourth or a fifth trial. Therefore the adoption of three trials for the standard method is justified.

Position of the Blocks in the Three Piles

Another preliminary study was the testing of 93 totally blind children in the Pennsylvania Institution for the Blind. Certain

features of the test stand out more clearly in the work of the blind than in the more rapid and less labored work of those who see. One feature observed was that when two difficult blocks or two that are often interchanged are picked up by the two hands at the same time, it is likely to confuse the child and to prevent his making the best record of which he is capable. The star and the cross are the most often interchanged by the blind and the lozenge and the enlongated hexagon by seeing children. This observation led to the rule that in piling the blocks for children who have vision the lozenge and the elongated hexagon must not be placed in the same layer in the piles. This usually prevents their being picked up simultaneously. It was also observed especially in the blind that if the star is picked up early in the trial and refuses to slip into place the child is often confused thereby and has unnecessary trouble with the other blocks. It was therefore decided that this, the most difficult block to fit into place, should never be left on the top of a pile. If picked up late in the trial it cannot disturb the handling of so many other blocks.

Relative Importance of Touch and Vision in the Test

The main purpose in testing the blind children was to get further evidence as to the relative importance of the visual and the tactual senses in the form board test. In spite of the fact that the child gets no tactile impression of the recesses while placing the blocks, it is the opinion of some examiners that touch is depended on considerably by children who see. Careful observation however, has shown that they usually pick up the blocks with no effort to get a tactile impression of them. In the tests with the smaller board no advantage was taken of the clearer tactile impressions which the smaller blocks must have given. Introspective reports of students of psychology who were given the test indicate that there is little dependence on touch. Some blindfolded children are unable to place the blocks at all, and blindfolded adults have great difficulty, requiring on an average about three minutes for the first trial. Table IV shows the

	Number of individuals	Average age	Average time in seconds	Average number of errors
Blind from birth	31	13	69	4.3
Vision lost before the age of three	32	15	53	3.8
Vision lost between the ages of three and ten	22	14	37	1.4

TABLE IV.—Results from form board tests of totally blind children.

records made by the blind. At the beginning of the test the child explored the board with his hands, examining every recess and handling its corresponding block. He was then given three trials, each of which was timed and a record was taken of the number of errors. The data given in the table are from the shortest of the three time records and the number of errors made in that trial. It might be expected that those who have been blind from birth would be the most successful in the test because of having always depended on the tactile sense instead of having adapted themselves to it after form and position had been learned visually, but the results do not fulfill this expectation. Those who had been blind from birth required the longest time for placing the blocks, an average of 69 seconds, while those who had retained their vision until after the age of three required on the average only 39 seconds. The average number of errors made by the two groups were 4.3 and 1.4 respectively,—further evidence of the difficulty of the test for those who had been blind from birth. Obviously they were hindered by something or else those who had visual experience were helped by something. The small age differences could not have provided the factor. Since the three groups differed in no other way, the better success of those who had had visual experience must have been due to something that they retained from it. The conclusion must be that they retained their visual imagery and were assisted

by it in the interpretation of their tactile impressions. The fact that those who lack visual imagery find the form board test so difficult indicates that vision is much more important than the tactile sense in the test; in fact this evidence added to that from observations and from introspections of normal subjects leads to the conclusion that the tactile sense is an almost negligible factor in the form board test.[3]

Summary

The conclusions from these preliminary studies have been reported on the preceding pages in the order in which they were reached. In the following summary they are more conveniently grouped.

1. Without a long and elaborate series of experiments (probably not worth while), one could not improve on the size, arrangement, and choice of forms as they appear on the standard form board.

2. In the test, the form board should lie horizontally on a table which is low enough to allow the child to lean over and look down directly upon the center of the board. The blocks should lie in three piles at the top of the board, with no block in the pile nearest to its recess, the lozenge and the elongated hexagon in different layers, and the star not at the top of a pile.

3. Goddard's method or a modification of it is the most promising for a quantitative study and for the establishing of norms and standards for comparing and ranking individuals.

4. This method cannot be standardized for children younger than five years of age because some of them cannot place all of the blocks without help other than urging. It is not worth while to establish norms for those above fourteen.

5. The tactile sense figures very little in this test.

[3] Fernald, Psychological Bulletin, X, 62; Sylvester, Psychological Bulletin, X, 210; Dearborn, American Journal of Psychology, XXIV, 204.

III

A STUDY OF THE FORM BOARD TEST IN ITS APPLICATION TO RETARDED AND DEFECTIVE CHILDREN

The first important study following the preliminary work was the testing of the children in the special backward classes of the Philadelphia Public Schools. At that time there were 45 of these classes with a total enrollment of about 780. Of this number some were foreign born children placed there until they could get a start in English, some were there for disciplinary reasons, and some because of deafness, poor vision, or other physical defects. These three groups were not included and a few other children were absent from school when the tests were made, so the total number tested was 616. The ages of 11 of these were not obtainable so their records were thrown out, leaving 605. Goddard's method was used, modified as to the piling of the blocks and in other ways to accord with the conclusions drawn in the preliminary studies. In addition the child was to be graded on as many features as possible. The teacher's estimate of the child and any other information that she could give concerning him were also to be used. The work was undertaken with three purposes; first, to determine which features of a child's work at the form board can be satisfactorily graded; second, to find which of the obtainable facts concerning him are of value in connection with the test; and third, to differentiate the characteristic ways in which children of various types work at the test. The first two of these purposes were successfully carried out but the third was not, the 605 children proving to be such a hetereogeneous group and the data so inco-ordinate as to defy all attempts at classification. The work had an additional value in serving as a preparation for the more careful quantitative studies of normal children. Improved ways of securing proper testing conditions were developed with experience and the procedure of the test itself was adjusted and smoothed.

Plan and Procedure

At the beginning the test was explained to the child quite fully, and during the explanation the examiner put all of the blocks into place and removed them once. As it had been decided to make the time element the main feature it was thought that the child should be given every chance to make his best possible record. (For a better procedure that was worked out later see page 34.) The child started each trial from the signals, "Ready—Go." The records of the handling of the blocks were taken by an assistant in the form shown in the accompanying chart. This specimen record shows that the child began by picking up block 6, trying it at recess 8, and then placing it in its proper recess. (See page 1 for form numbering.) Next blocks 9 and 3 were placed correctly. Block 0 was tried at recess 1, then unsuccessfully at its own recess, then at recess 5, and finally it was fitted into its own recess. Two errors were made with block 8 and one with block 1. Block 5 was tried at recess 4 and laid aside, then blocks 4, 2, 7, and 5 were placed in order. Thus the handling of every block in the first trial is shown. At the foot of each column is recorded the time of the trial in seconds.[1]

FIRST TRIAL	SECOND TRIAL	THIRD TRIAL
686	939	9
9	725867	6
3	2	5
01050	81508	383
8548	515	1
141	3	4
54	606	7
4	0	828
2	1	020
7	4	2
5		
61 sec.	77 sec.	49 sec.

The investigator besides handling the stop watch recorded his estimate on the child's co-ordination, apparent mentality, ability at planning ahead, and use of the hands. From the teacher were obtained data including the child's age, reasons for his being in the special class, whether she regarded him as mentally defective or as merely retarded, his general school progress, and her estimate of his ability at hand-work. At the beginning the investi-

[1] This is Goddard's method of taking the record.

gator undertook to estimate certain other features such as interest, attention, alertness, and learning ability, but one by one they were dropped as it became evident that they could not be estimated in such a way as to have a bearing on the test. After some 200 children had been tested, it was evident that there was another feature which should have been included, namely, poise. The remainder of the children were graded on this. Exactly what is here meant by poise is made clear in the discussion of results (page 19).

Age and Sex Considerations

After various attempts had been made at arranging the data it became evident that the time records have the most consistent variability and are therefore the best basis for arrangement. The grouping above the 18 second records in table V is more or less forced but it is the least objectionable of any that were tried. In the first columns at the left are shown the number of individuals in each time record group, their distribution by ages, and their average ages. Even these sub-normal children show some correlation between age and the time required for placing the blocks. In the column of average ages there appears a gradual increase of age from the 40-49 second group to the 10 second group, but the distribution shows that the shortest records were made not by the oldest but by the fourteen year old group. The shortest records focus toward that age. Arranging the data in a way not shown in the table it is found that the average time record for each age is as follows:

Age	7	8	9	10	11	12	13	14	15	16	17
Av. time	22.6	23.7	20.9	19.4	19.1	17.5	16.6	15.0	16.8	16.5	16.6

The fact that the fourteen year old group made shorter records on an average than the older ones is due to the brighter children dropping out of school after the age of fourteen, which is the limit of compulsory education. Why this elimination is selective, leaving the less capable individuals in the special backward classes, is not pertinent to this study.

Sex distribution is of little importance. For reasons not of

Time in Seconds	Number of Individuals	Distribution by ages											Average age	Sex	
		7	8	9	10	11	12	13	14	15	16	17		Male	
Unfinished	6	1			2	1	1			1			10.8	4	
50-101	15	1			3	3	3	2	1	2			11.7	7	
40-49	21	1	10	2	2		3	1	1		1		9.7	7	
30-39	24	1	3	4	5	5	1	2	2	1			10.5	15	
26-29	33	1	5	2	6	8	4	3	2	1	1		10.8	22	
23-25	41	1	4	8	5	11	6	1	2	2	1		10.7	27	
21-22	46		1	5	8	9	6	6	5	4	1	1	11.8	27	
19-20	60		2	8	8	10	12	7	5	6	2		11.7	49	
18	61		1	3	5	13	22	8	6		3		11.9	51	
17	49	1		2	1	12	12	9	7	4	1		12.3	35	
16	68			3	13	8	11	16	7	7	3		12.3	61	
15	60				3	6	8	17	14	4	7	1	13.3	52	
14	62				1	7	13	9	16	9	6	1	13.4	54	
13	31				1	2	7	4	13	3	1		13.3	28	
12	15						1	5	7	2			13.7	15	
11	10						1	1	7	1			13.8	10	
10	3								3				14.0	3	
Total	605	7	26	37	63	95	111	91	98	47	27	3		467	1

TABLE V.—The data from the 605 backward class children.

interest here, a relatively small number of girls are placed in the special backward classes. It is a matter of observation confirmed by these results that the girls of these classes, as a group, are more backward than the boys. The table shows that the shortest form board records were made by boys entirely. The average for all records was 20.3 seconds for boys and 26.2 seconds for girls. Obviously the girls of a mental grade corresponding to the brighter boys in the backward classes were left in the regular classes. If equal numbers of boys and of girls were selected for the special backward classes they would be more nearly of the same grade of mentality and their form board records would be more nearly equal. Later form board tests of normal children revealed no sex differences.

THE TIME RECORDS IN RELATION TO SCHOOL WORK ABILITY AND TO MENTALITY

The main purpose of the columns on school progress, hand-work, and mentality is to give the reader information concerning

hool progress		Hand work			Mentality							
Poor	Very poor	Fair	Poor	Very poor	Retarded	Doubtful	Defective	Using both hands to place blocks	Very poor in coördination	Seriously lacking in poise	Planning the work ahead	Average number of errors
	6			6			6		1			
	15		1	14		2	13		7			36
2	19			21	1	4	10	1	12	2		17
5	19			24	2	4	18		10	5		15
6	26		4	29	5	10	18	4	9	9		9
10	30	3	6	32	12	10	19	5	11	9		7
6	38	1	9	36	10	15	21	7	12	8		5
18	39	4	16	40	23	13	24	9	15	13		6
12	49	6	17	38	18	22	21	12	12	10		5
6	41	5	15	29	23	8	18	14	12	1		5
16	47	8	18	42	34	9	25	20	13			3
13	45	6	23	31	32	12	16	13	14		6	4
10	51	17	16	29	40	12	10	25	2		8	3
7	10	6	6	19	19	7	5	21	3		12	4
3	9	2	3	10	14		1	14			13	3
3	6	3	4	3	7	1	2	10			10	3
1		2	1		3			3			3	3
118	459	63	139	403	243	129	233	158	133	57	52	

TABLE V.—Concluded.

the kind of children that were tested. The grading calls for explanation. School progress and hand-work were reported by the teachers on a three point scale: fair, poor, and very poor, the standard being that of ordinary school children. Aside from showing a much stronger correlation between hand-work ability and form board ability than between school progress and form board ability, the data contributes little except that it helps to give a notion of the personnel of the groups of children.

Unfortunately no good estimate of the grade of mentality of each child could be made. Had they been graded or grouped according to some approved scheme of mental classification it would have aided greatly in the interpretation of the form board results. The best that could be done was to record the investigator's estimate of the child's mentality after he had watched him through the form board test and perhaps asked him a few questions. There was also recorded the teacher's estimate based on her impression of the child as her pupil. A two point grading was adopted; all being graded either as *retarded* or *defective*.

The criterion was that those placed in the lower group, the defectives, had evidently been subnormal from birth and could never have been trained to economical and social independence. This classification is far from satisfactory and it involves a further misuse of the already over-worked terms, *retarded* and *defective,* but it served fairly well for a common basis for estimates by teacher and investigator. In cases where the two agreed there was some likelihood of their being correct. The middle column, marked *doubtful,* contains 129 cases on which the opinions of the examiner and the teacher disagreed. It is unfortunate that this number should be so large, but it is likely that most of them were borderline cases or cases not easily understood. The distribution in the *retarded* and the *defective* columns indicates that the former group did the test much the more successfully. The average time records for the two groups were 16.5 seconds and 30 seconds respectively. Although the grouping is no doubt faulty, there is certainly strong evidence here of a correlation between mentality and ability at the form board test.

Important Features Other Than Time and Errors

The four columns next to the last in table V give the data which it was found can be taken in connection with the form board test and which contribute to the value of the test in diagnosis. First is shown the number of children of each time record group who used two hands successfully and simultaneously in placing the blocks. As compared with normal children (see page 50) a relatively small number did this. One feature observed but not shown in the table is that several of the older children who used but one hand at a time, changed from one to the other in successive trials, apparently succeeding with one as well as with the other. Normal children rarely change hands.

In muscular co-ordination 133 were graded as very poor. Incoordination is not so noticeable in children whose mentality is such that they attempt no quick or accurate movements, so these results do not mean that all but 133 of these 605 had good coordination.

Poise, as here used, means the ability to work at one's maximum speed without losing control and getting confused. When a child in his efforts to place the blocks quickly, over hurries and gets flustered so that he makes numerous and inexcusable errors or hesitates in a semi-dazed way, he does so because he is lacking in this quality which we have chosen to call poise. Take for instance one of these backward cases, an eleven year old boy whose record for the three trials in order were 36, 52, and 62 seconds, and the number of errors 4, 5, and 11. His efforts at hurrying caused him to make errors and to lose time. When given a fourth trial and told to work slowly he placed the blocks in 21 seconds and made no errors. Some defectives show a lack of poise as soon as they begin to work rapidly. Urging by the examiner is likely to throw them into confusion. Later studies of normal children showed that although they are sometimes momentarily hindered by over hurrying, they do not go into utter confusion. Practically all of them make better records when urged by the examiner during the work. In other words, the child who is lacking in poise is very likely not of normal mentality. As previously stated, no records were kept of this factor until the children in several of the classes had been tested. Of 377 who were marked on poise, 57 were graded as seriously lacking in the quality. (Table V.) Many of these 57 were of the excitable defective type; others could not be called defectives but they were mentally retarded because of nervous trouble. Many of them made numerous attempts to fit blocks into wrong recesses, the average of the 57 being 7.3 errors each. Poise is a detail which the examiner can observe to advantage. It is important not only in extreme cases, but in the many who momentarily lose control or show a tendency to do so there is often some instability that calls for further study.

By *planning ahead* is meant that before the signal "Go", the child glances at the blocks on the top of the piles, then at their recesses and is thus ready at the signal to shoot them into place without hesitation. Most normal adults and many children do this (See page 50) but younger children do not. Only 52 of

these backward class children did so, according to table V. An individual is credited with planning ahead if he does it on one or more trials.

The Records of Errors

In the last column of table V is shown the average number of errors made by each individual in all three trials. For the extremely long time records the average number of errors is 36, for the shortest records the average is 3, and between these extremes there is a somewhat irregular correlation between the length of time record and the number of errors. These 605 backward children averaged more than 6 errors each, whereas normal children average less than three (chart III, page 36). Evidently a large number of errors indicates low mentality.

A statement of the number of times that each possible kind of error was made is given in table VI. Horizontally the spaces

		Recesses										
		1	2	3	4	5	6	7	8	9	0	Total
Blocks	1	4	6	3	62	81	3	4	63	1	15	242
	2	20	2	24	32	19	9	14	12	9	75	216
	3	7	16	4	3	9	18	16	7	62	42	184
	4	38	3	9	4	102	3	6	31	4	99	299
	5	23	4	2	45	4	5	17	58		4	162
	6	9	5	8	6	12		55	67		31	193
	7	21	17	23	15	65	67		68	4	97	377
	8	111	4	5	61	159	24	9		1	35	409
	9	2	19	110	4	10	16	3	4	7	20	195
	0	41	60	15	305	116	8	27	61	8	2	643
Total		276	136	203	537	577	153	151	371	96	420	2920

Table VI.—Distribution of the kinds of errors made by the 605 backward class children. The upper line, for instance, indicates 4 futile attempts to fit block 1 into its own recess, 6 attempts to fit it into recess 2, 3 at recess 3, 62 at recess 4, etc., and a total of 242 errors with this block. Since each of the 605 children had three trials, a total of 1815 errors with each block was possible. (See footnote, page 23.)

represent the ten recesses of the form board and vertically they represent the ten blocks. The numbers in the upper horizontal line show the number of futile attempts at putting block 1 into each of the ten recesses. Four attempts at its own recess failed and there were six attempts at recess 2, three at recess 3, sixty-

two at recess 4, and so on for the others. The other horizontal lines give corresponding data for the other blocks.[2] According to this table, by far the most frequent error was that of attempting to put block 0 into recess 4. The only possible errors not made were 5-9 and 6-9 and futile attempts to fit block 6, 7, and 8 into their own recesses.[3]

One important conclusion is to be drawn by arranging the data in the form of table VII. Here the twelve most frequent errors[4]

Time in Seconds	Kind of Errors											
	0-4	8-1	8-5	6-8	7-8	4-0	1-4	3-9	9-0	6-7	0-5	9-3
30 to 101	4	3	4	2	2	2	2	3	3	2	2	4
20 to 29	11	4	7	3	3	4	2	2	4	3	5	6
15 to 19	15	4	6	2	3	5	2	2	3	1	5	3
10 to 14	16	5	7	2	1	5	3	2	3	2	4	2

TABLE VII.—The twelve most frequent kinds of errors of the 605 backward class children arranged according to the time records. The data is in per cent. of the total number of errors made by each of the four time record groups. Thus, the 4 in the upper left space means that of the total number of mistakes made by the group whose time records were 30 seconds or more, 4 per cent. were the 0-4 error.

are arranged according to four time record groups,—those longer than 29 seconds, the 20 to 29 second records, the 15 to 19 second records, and those shorter than 15 seconds. This is a condensation of the grouping that is used in table V. The data are given in percentages of the total number of errors made by each group. In table XIV, page 40, it is shown that with normal children of all ages the 0-4 error is by far the most frequent and that the

[2] In this enumeration of kinds of errors, all three trials are included but only the first wrong recess tried with each block. For example, from trial I in the record shown on page 14 there was taken only the 6-8, 0-1, 8-5, 1-4, and 5-4 errors. The failure to fit block 0 into its own recess and the attempt with this block at recess 4 are not included. This is necessary because only the first error is made directly after the child has looked at the block in the pile and glanced over the board for its recess. The errors after this first one are made under various conditions and so do not merely represent a failure to perceive the relation of block to recess.

[3] Where the kind of error is designated by two numbers separated by a dash, the first number names the block and the second the recess.

[4] The twelve most frequent errors are almost the same in tables VII and XIV. They are arranged here according to their frequency in the latter, in order that the two tables may be compared.

occurrence of the more common ones does not vary significantly with age. In table VII the same is true of the two groups whose time records average below 20 seconds and to a less degree of the 20 to 29 second group, but in the longest records group there is little tendency to make one kind of error more frequently than another. Since nearly all of these longest records were made by children of quite low mentality, the one conclusion to be drawn is that if a child makes the 0-4 error and the other common ones more frequently than others he is to be *credited* for doing so. In other words, he is probably of higher mentality than a similar child whose errors are more evenly distributed. This feature is peculiar in that it varies with the degree of mentality but not with the age and it is therefore especially important.

Summary

This study of retarded and defective children yielded the following conclusions:

1. Those children whose time records were the longest are generally of the lowest mentality.

2. It is impracticable to record observations on interest, attention, alertness, and certain other features in a regular manner. In cases where they are important they must be recorded in the examiner's general notes or in connection with other tests and parts of the examination. Muscular co-ordination and poise are splendidly revealed in the form board test and are well worth grading, and records should be made of whether two hands are used at the same time successfully and whether the child plans ahead.

3. Records of the handling of the blocks can be satisfactorily taken and are of great value. The greatest number of errors occur in the long time records and are made by children of low mentality.

4. Some kinds of errors are more common than others. A tendency toward making more of certain errors than of others indicates higher mentality than does a tendency to make one error as often as another.

IV

A SPECIAL STUDY OF THE TIME AND ERROR FEATURES OF THE FORM BOARD TEST

The most serious difficulty to be met in the study of age variations in the results of any test lies in the differences of advancement of the individuals in each age group. Every child is more or less retarded or precocious, or both. Not only may his physiological age, his mental age, his pedagogical age, and his chronological age be at variance with each other but there may be a wide range of variation within each except the last. For instance, a child ten years of age pedagogically (that is, in fourth grade at school) may be well advanced in reading but very backward in writing or arithmetic. Physiologically he may have the muscular co-ordination of a twelve year old but only the muscular strength of a child two or three years younger. Mentally he may pass the digit memory test of the twelfth year Binet questions but fail on the ninth year definition question. Excluding defectives and other noticeably peculiar individuals, one still has in ordinary children of a given chronological age, a most heterogeneous group. The ages are scattered over the entire year so that an eight year old child may be 360 days older than certain others of the eight year old group but only a day or two younger than some of the nine year old group. To smooth out such variations and to obtain reliable results in a study of age changes requires a huge mass of data, the collecting of which is impracticable in a study such as this one with the form board. Under the most favorable circumstances only ten to fifteen children can be tested in an hour. In the present investigation the difficulty was partly met by testing strictly limited groups of children, selected according to requirements which partly eliminated the factors causing the heterogeneity. Reasonably extensive data from

groups as nearly homogeneous as careful selecting could make them were collected.

Selection of the Children

Five hundred children were tested; 25 boys and 25 girls of each age from five to fourteen inclusive. Reasons for these age limits have been given on page 9. The requirements were as follows:— (1) The birthday of each child selected came within a month of the day on which the test was given. This made the ages nearly exact by years. (2) He was neither retarded nor accelerated pedagogically according to Philadelphia Public School standards. That is, the fourteen year olds were selected from the eighth grade, the thirteen year olds from the eleventh grade, and so on down to the eight year olds from the second grade. On this scale seven year olds would have been taken from the first grade and there would have been no grade for six year olds. The best that could be done was to select seven year olds from the upper first grade and six year olds from the lower first grade. Five year olds were selected from the kindergarten. (3) Each child was American born and his parents' name and occupation indicated nothing in race or in home conditions especially favorable or unfavorable. Colored children were excluded. (4) He was free from physical defect and there was nothing peculiar or striking in his personal appearance. (5) Mentally he was not especially bright or dull or in any way different from ordinary children.

The method of selection was as follows: The investigator took from the school records the names of children meeting the first three of the above requirements. Principals and teachers checked off from these lists the names of those who in their opinion did not meet the fourth and the fifth requirements. Finally, when the children appeared at the testing room the investigator rejected those whose personal appearance led him to suspect and physical or mental peculiarity. This was the final elimination. All children who were admitted to the test were allowed to complete it and no records were thrown out. The elimination by these requirements was heavy, the records of some 11,000 chil-

dren being gone over before 500 meeting the requirements were found.

A difficult part of the work was the securing of conditions favorable to the children's assuming the proper attitude toward the test. As compared with the carefully controlled conditions of most experiments in the psychological laboratory, it is almost presumptuous to report as psychological tests, work done in a public school and especially by an investigator who is a stranger in the school. If one, however, keeps in mind the ideal of psychological laboratory conditions and does not allow himself to proceed when conditions are not at the best, he is well repaid for it in the reliability of his results. First it is necessary to secure the good will and the co-operation of principals and teachers. If they are impatient and not interested the children will not do their best. Then the children must be dealt with tactfully. Some older boys and girls are inclined to regard the tests as too childish for them, and the little folks are likely to associate it with medical inspectors, throat examinations, and vaccinations. From the experience gained in the preliminary tests and in the tests in the backward classes, there had been worked out a definite plan of procedure which reduced the disturbance of the school to a minimum, usually secured the hearty co-operation of principals and teachers, and put the children into the proper attitude toward the investigator and the test. In a few cases after the work had been begun in a school, it was postponed or abandoned because of some disturbing influence or lack of co-operation on the part of the principal. No tests were given under unfavorable conditions.

The testing procedure was that described on pages 14 and 15, except that the investigator himself took no data. He held the stop watch and otherwise gave his attention to the management of the test.

Reduction of the Records to Time Indices

The data thus collected consisted of individual records of the 500 children showing the time required for each of the three trials and the order in which the blocks were handled, with occasional

observations dictated by the investigator at the end of the test. The first problem to be taken up in the study of the time records was that of reducing each individual's record to a significant value which would stand as an index of his form board ability. In the preliminary studies it had been found that the time of the third trial would be a more reliable index than the time of either of the others. (Page 9.) And according to the usual procedure in psychological tests, especially where practice is so strong a factor, the time of the third trial would be taken as the index. But Witmer's emphasis on the importance of the child's first efforts suggests the use of the time of the first trial as the index, and he would probably record this if he were to keep a time record. Woodworth also favors the use of the first trial record. But the evidence in the preliminary studies was that this trial's results are too irregular to be reliable. Goddard takes the shortest of the three trials for the index. Whipple[1] and Franz[2] use this shortest of three trials index in some of their strength tests. A fourth method of scoring suggests itself,—taking the average time of the three trials as the index. This would include the third trial, the first trial and the shortest trial, giving weight to each.

The distribution of records arranged according to each of these four standards is shown in tables VIII, IX, X, and XI, and their curves of averages of time records for each age are shown in chart I. It is quite remarkable that the four curves run so nearly parallel. So far as is shown in the curves themselves, any one of them could be used as the standard index without serious error, the time averages for the different ages varying in about the same way in all. But variability of individual records indicates that these four standards applied to individual cases would give very different rankings. Take for instance two of the fourteen year old records. A's record is 14, 11, and 9 seconds for the three trials, and B's record is 9, 11, and 10 seconds. Now with the shortest trial as the standard for an index A and B did

[1] Manual of Mental and Physical Tests, pp. 71, 75, and 80.
[2] Mental Examination Methods, p. 49.

Time in seconds.	5	6	7	8	9	10	11	12	13	14
103	1									
86	1									
68	1									
61	1									
56	1									
51	2									
50	2	1								
49										
48	2									
47	1	1								
46	2									
45	2									
44	2	1								
43	1									
42	3									
41	2	2	1							
40	4	1								
39	2		1							
38	2	1								
37		3	1	1						
36	1	2			2					
35	2	1								
34	3	2			1					
33	1				1					
32	1				1					
31	1	1	2	1						
30	1	6	1							
29	2	3	3	2		1				
28	2	2	5	3	2					
27	2	4	3	1	1					
26	1	2	1	1	3	1				
25	1	2	3	4	2					
24		7	2	2	2		1			
23		2	4	5			1			
22		3	5	4	2	1	1			
21		1	3	6	6	6	1		1	1
20		1	5	7	6	3	1	1		
19			4	8	5	4	5	1		1
18			3	3	4	7	4		1	1
17					8	10	6	3	2	2
16		1	1	2	4	7	6	3	5	6
15			1			5	12	9	9	5
14						3	9	10	10	10
13			1			1		11	8	7
12						1	1	5	6	6
11							2	3	4	6
10								2	3	2
9								2	1	3
	5	6	7	8	9	10	11	12	13	14
					Age.					

TABLE VIII.—Distribution of the *first trial* time records.

Time in seconds.	5	6	7	8	9	10	11	12	13	14
95	1									
71	1									
57	1									
50										
49	1									
48	1									
47										
46	2									
45		1								
44										
43										
42	1									
41										
40	1									
39	3									
38	1									
37	4	1								
36	3									
35	1									
34	1									
33	2									
32	3	3								
31	6									
30	3	1	1							
29	4	3			1					
28	1	2	2							
27	3	2	2		1					
26	2	2	3							
25	3	2	2		1					
24	1	8	2	4						
23		5	6	3						
22		6	5	6	2					
21		9	9	7	1					
20		2	5	6	7		2			
19		2	5	6	8	1		1		
18			4	9	7	5				
17		1	3	4	9	5	2	1		
16				1	7	8	8	3	1	
15				3	4	9	10	3	4	1
14			1	1	1	9	11	11	8	4
13					1	7	9	13	8	6
12						1	6	8	9	11
11						4	1	8	11	16
10						1		2	6	10
9							1		3	2

Age.

TABLE IX.—Distribution of the *third trial* time records.

Time in seconds.	5	6	7	8	9	10	11	12	13	14
83	1									
71	1									
50										
49	1									
48	1									
47										
46										
45										
44										
43	1									
42	2									
41	1									
40										
39	1									
38	1									
37	3									
36	3									
35	3									
34	2	1								
33	1									
32	1	2								
31	4	2								
30	1	1								
29	5	2								
28	2	2								
27	5	2								
26	5	3	1							
25	4	3	1							
24	1	6	3	1						
23		6	4	3						
22		9	4	4	1					
21		4	14	7						
20		3	5	7	3					
19		1	7	6	9			1		
18			6	9	10	2	1			
17		1	3	7	11	8				
16		2		2	10	9	5	1		
15			1	3	4	9	7	3	3	
14				1	1	8	19	8	3	3
13			1		1	9	10	13	9	3
12						3	4	12	12	9
11						1	1	9	12	17
10						1	2	3	7	12
9							1		4	6

Age.

TABLE X.—Distribution of the *shortest trial* time records.

Time in seconds.	5	6	7	8	9	10	11	12	13	14
103	1									
79	1									
62	1									
50	4									
49										
48	2									
47										
46										
45										
44	2									
43	1									
42										
41	2									
40	4		1							
39	2	1								
38	4									
37	1									
36	1	2								
35	4	1								
34	1	5	1							
33	2	1								
32	2	1								
31	4	1	1							
30	2	2								
29	6	6								
28		3	2		1					
27	3	3	2	1						
26		4	7	2						
25		5	4	3	1					
24			7	4	2					
23		4	6	4	1					
22		8	1	5	3					
21		1	5	9	7	3				
20		1	7	6	8	1	1	1		
19			2	5	7	3	2			
18		1	2	6	8	8	2			
17			1	3	7	10	8	1		
16				2	3	6	9	4	4	1
15					2	11	13	7	5	4
14			1			5	9	13	9	5
13						2	3	12	13	14
12						1		7	10	14
11							3	4	7	8
10								1	1	3
9									1	1

Age.

TABLE XI.—Distribution of the *average of three trials* time records.

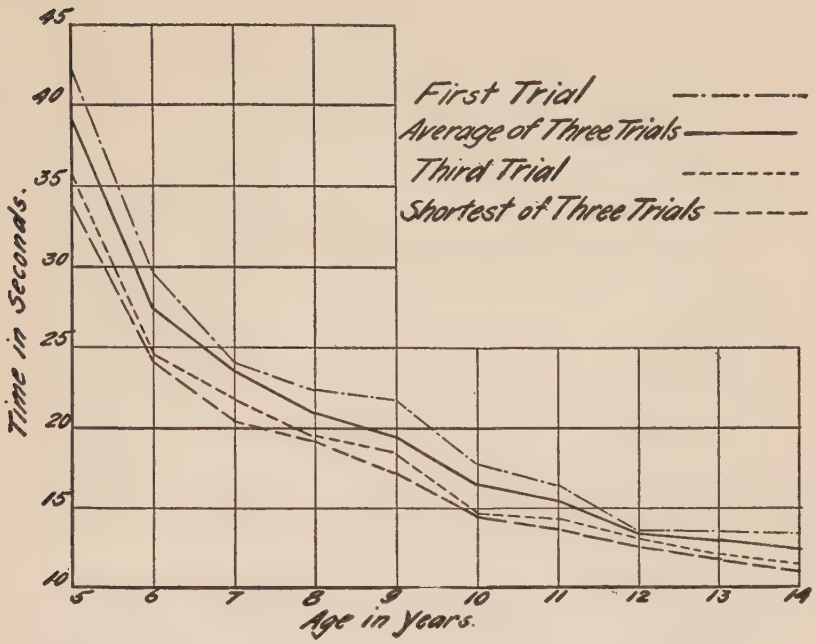


CHART I.—Averages of the time records of the 500 selected children.

the test equally well, the index for each being 9 seconds. With the third trial as the standard A did better than B, the indices being 9 and 10. With the first trial as the standard B did better than A, the indices being 9 and 14. With the average of three trials as the standard B did better than A, the indices being 10 and 11. These are extreme cases but they emphasize the importance of choosing the right one of these standards.

Since variability is the great disturbing factor, that standard which gives the lowest and most regular variability is probably the best of the four. This criterion immediately eliminates the *first* trial standard, chart II showing that its variability curve is both higher and more irregular than the other three. The curve for the *third* trial's variability is fairly low and smooth but this trial as a standard is eliminated by the results shown in table XII. This table shows that of the 500 records there were but 177 (138 + 39) in which it was the lowest, and in 207 (10 + 10 + 59 + 105 + 12 + 11) either the second or the first was the

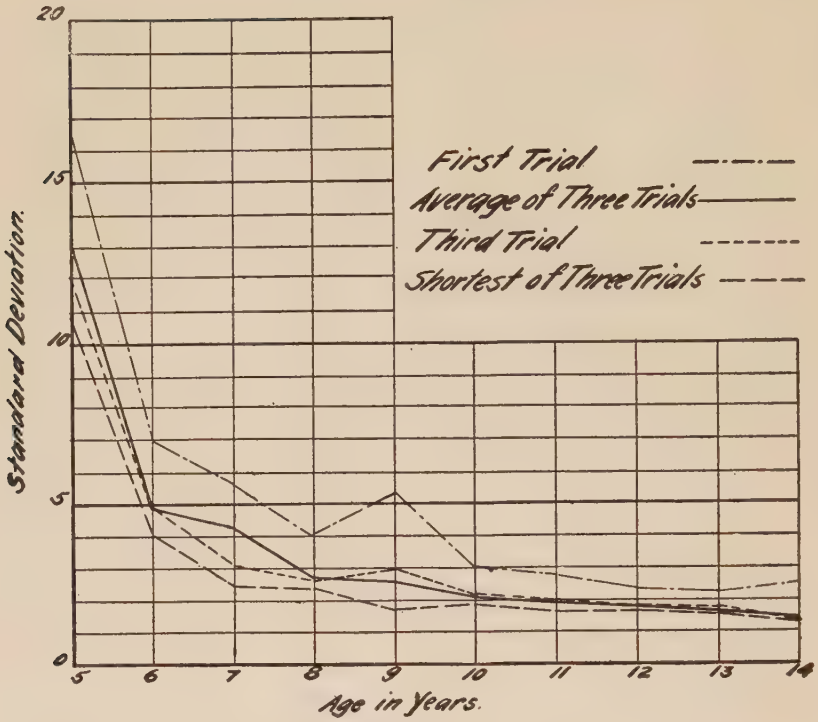


CHART II.—Standard deviations for the data of Chart I.

Relative lengths of the three trials.	Ages 5	6	7	8	9	10	11	12	13	14	Total
I = II = III						2		3	3	2	10
I = II < III				2		1	2	1	3	1	10
I = II > III		2	2	6	4	4	7	6	5	3	39
I > II = III	2	5	6	10	7	5	7	9	3	5	59
I > II < III	13	11	16	13	11	7	12	7	8	7	105
I > II > III	17	18	17	11	12	14	7	5	16	20	138
I < II = III	1	1	1		3	1		1	4		12
I < II < III	2	3	2		1			2		1	11
I < II > III	15	9	6	8	12	16	15	16	8	11	116
Total	50	50	50	50	50	50	50	50	50	50	500

TABLE XII.—Results for each age in terms of the relative lengths of the three trials. The =, > and < signs indicate the relative lengths of the time records of the three trials. The numbers in the body of the table show the number of individuals of each group whose three time records were in each of the possible combinations of relative lengths.

lowest. Although practice is probably the dominant factor in the variability of the length of time records, the presence of other important factors is shown by the many individual cases in which the first trial or the second trial was shorter than the third. Observation of children working at the test reveals the fact that over-hurrying, change of method of handling the blocks, or difficulty in getting some block down into its recess, may make the third trial longer than the others, and that there is an element of luck which makes the third trial index an unfair one in many cases. This standard is therefore undesirable.

Taking up the *shortest* of three trial index one finds in chart II that its curve is the lowest and is almost as smooth as any. The smoothness of the curve for the *average* of three trials is somewhat discounted because of its representing averages of averages, its position for each age being determined by the average of 150 time records while the corresponding positions of the other curves are determined by averages of 50 time records each. By the criterions of amount of variability and regularity of variability, the shortest of three trials is therefore the best of the four standards.

After this statistical study which led to the choosing of the shortest trial standard some time was spent in studying individual children, following the form board test with a thorough mental examination. In many cases the shortest trial index was found to be unsatisfactory and in some it was quite misleading. It was found that if the time records of the first trial and of the shortest trial were averaged, an index was obtained which usually agreed with the conclusions from mental examination of the child. Obviously, therefore, the first trial was of such importance that it could not be neglected. It was then decided to adopt tentatively the average of three trials as a standard. Applied to the records of the cases that had been examined and to several additional ones, it proved to be the most satisfactory of anything that had been tried. Without doubt, the average of three trials is a more reliable index to the mentality of a child than is any other single

numerical index, but even this is too mechanical and in many cases is misleading.

While this application of the average of three trials standard to individual cases was being made, another method suggested itself. It was tried on a number of cases and the preceding data were gone over from the new point of view so far as possible. It proved satisfactory and was welcomed because it included important features of the test which in the effort to reduce the records to the form of an index of one number, had been reluctantly excluded. The method is as follows. The child is introduced to the test with practically no instruction concerning it, merely the remark, "Let us see how quickly you can put the blocks into place". His first reactions are studied and full note is taken of his behavior and of his efforts until he succeeds in getting the blocks into place, or shows that he cannot do it. After this first trial, any instruction necessary is given to make him understand where the blocks belong and that he is to replace them as quickly as possible. Then the second and the third trials are given, starting him each time from the signals, "Ready—Go", urging him and giving him every chance to make the best possible records. The shortest of the two time records is taken as his time index. This with the notes taken on the first trial and the records of the handling of the blocks as taken by an assistant, constitutes the standard record. This method allows the use of Witmer's idea of carefully studying the first trial and at the same time it permits the use of the shortest trial time index which statistical checks had shown to be the most satisfactory. Most normal children proceed to place the blocks properly without instruction, and so make a fairly good time record on the first trial. An occasional child will fail to set the blocks entirely down into place or will even fail to lay them upon their proper recesses. These can easily be set right before the second trial. Of defective children, some require considerable help and several startings before they understand what is to be done. All of this is to be reported in the first trial notes. It was shown in table I that fourth and fifth trials usually differ little from the third trial, so even if con-

siderable practice is allowed in this so-called first trial, it will make little difference.

Correlation of Time Records With Age

This rambling search for a method of treating the data, and the consequent adoption of a new method of conducting the test came of course, after the data from the 500 selected children has been taken. All of the tests had been given in exactly the same way and under the strict requirements laid down at the beginning. While it is to be regretted that the data were not taken with an uninstructed first trial, as in the method finally adopted, it makes absolutely no difference in the following results and conclusions which are limited to variability of time records with age and sex. The averages may be slightly lower than they would have been by the new method, but excepting the coefficient of correlation, every result is shown clearly by the curve for each of the four standards that have been considered. The conclusions are drawn from the direction of the curves and not from their heights, so they apply to the new method whose curve (See chart IV, page 49) differs from that of the shortest of three trials much less than those of the other three standards do. With an uninstructed first trial the errors might not have been exactly the same, but for the purposes for which the records are here used the difference is negligible.

The general direction of the curves in chart I shows a negative correlation between age and the time required for placing the blocks. The coefficient of correlation for the shortest of three trials standard calculated by Pearson's products-moments method is 0.384. Considering the bold curve taken by the line of averages, this is not a low correlation. If the records for the five year old group are not included the coefficient is 0.465.

Age Variations

In studying the age variations it is advantageous to consider simultaneously charts I, II, and III. The first two have been mentioned. Chart III shows the average numbers of errors made by children of each age. According to charts I and II many five

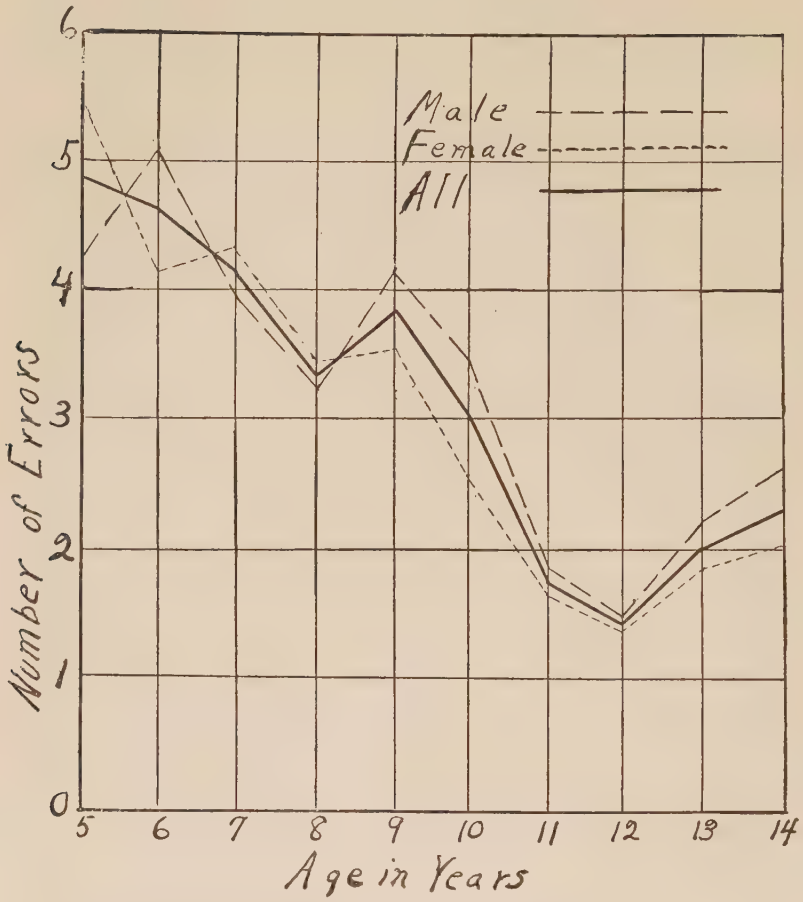


CHART III.—Average number of errors in three trials.

year old children require a long time for placing the blocks, both the average time and the variability being very high as compared with the other age groups, but chart III shows that in the number of errors the five year old group is comparatively not so high. These facts are easily understood by anyone who has watched five year olds working at the test. They move slowly in handling the blocks and cannot be made to hurry, working so deliberately that were their form perception as keen as is that of older children, they would make no errors. The number of errors made is therefore relatively low as compared with the curve of the time

records. A few of them hurry, this fact partly accounting for the wide range of the time records. The records are evenly distributed from these shorter ones to the extremely long ones, showing no mode or modes. Fatigue and a waning of interest are noticeable in some five year olds, but probably in no other age. A few six year olds work slowly and so avoid making so many errors. Except for these few children, six year olds are much more like seven year olds than they are like five year olds in this test. Considerable emphasis is sometimes laid on the effects of second dentition on seven year old children.[3] Some of the curves in these charts are a bit irregular at this age but on the whole the seven year olds seem to hold their own with other groups. Nine year olds fail to do this, their curves showing decided irregularities. There is no explanation at hand for these erratic tendencies, but it is a common observation by principals and teachers that nine year olds are the most puzzling children they have to deal with at school. Gilbert's curves show irregularities at this age.[4] Goddard[5] and Wallin[6] have found in separate investigations that the Binet tests for nine year olds are more uncertain than for any other age.

It seems that in form perception and motor ability, as they are required in this test, there is practically no gain after a point somewhere about the age of twelve. The better records made above that age are due to planning and to more determined effort. In these charts we find that at ages thirteen and fourteen the blocks were placed more quickly than at twelve, the standard deviations were lower, but the number of errors was greater. To those who have observed the testing of these older children it is evident that hurrying is the cause of the errors. In order to place the blocks in less than twelve or fourteen seconds, the child has to handle them so rapidly that there is not time enough to

[3] Chamberlain, The Child, p. 70 and ff. Gilbert, Yale Psychological Laboratory Studies, II, 93, and preceding tables and charts.

[4] Ibid.

[5] Reported in public addresses.

[6] Reported before American Psychological Association, Dec., 1911.

perceive the block's form and then to compare its image accurately with the recess forms. Eye movement, mental processes, and hand movements must go on simultaneously and very rapidly, and it is necessary to take a chance that the first impression of the shape of a form is correct. So these errors are not caused by inability to perceive form, but by a blurred and incomplete perception due to the rapidity of the work. Yet this gives the same result as inability to perceive form, for these older boys and girls confuse most often the same forms that the slow working young children do. Table XIV shows that for all ages the 0-4 error is by far the most frequent; for both five year olds and fourteen year olds about 12% of the errors being of this one kind.

The practical conclusion to be drawn from these studies of the age variations is that the time required for placing the blocks varies with age of children: that excepting five year olds, averages or modes of records for each age should be quite reliable as standards with which to compare individual records.

Sex Differences

Sex differences are of no importance in the form board test. The average of time records for boys are slightly below that for girls, the two being 17.8 and 18.2 respectively. Boys, especially the older ones, enter into a "Ready—Go" test more energetically than do girls, but the extra errors that they make because of hurrying partially sets them back. So their average gain in time, as shown above, is only 0.4 seconds. This gain is not evenly distributed by ages. The fact that at ages eleven and twelve, girls make the better records and at thirteen and fourteen the boys excel is probably due to changes connected with puberty.[7] However that may be, there can be no doubt as to the effect of the greater hurrying so noticeable in older boys. It is clearly shown in the shortness of their time records at ages thirteen and fourteen in chart I, and in the large number of errors made at those ages as shown in chart III. Standard deviation charts for

[7] Burnham. Ped. Sem. I, 181; Bryan. Am. Jour. of Psych. V, 173; Gilbert, cited above.

the two sexes are not given because no sex differences are apparent in them.

Kinds of Errors

The number of times that each kind of error was made is shown in table XIII which gives for the 500 selected children data corresponding to that in table VI (page 20) for the backward class children. The most frequent error was that of attempting to put block 0 into recess 4. This error occurred 255 times. Block 0 was misplaced more frequently than any other, altogether 391 times out of the possible 1500. This is due partly to its form and to the diagonal position of its recess, and partly to the fact that the recess is often hidden by the right arm of the child. The only forms not once confused with each other were 3 and 1, 9 and 1, and 9 and 5. Block 9 was the most often placed correctly, its record being only 58 misplacings out of the possible 1500. From these results it is not worth while to attempt to draw conclusions as to the relative complexity of the forms, their resemblances, and the effects of the different positions of the recesses. These matters if worth investigating, would demand an elaborate study based on facts of form perception and visual illusions which have not yet been worked out.

		Recesses										
		1	2	3	4	5	6	7	8	9	0	Total
Blocks	1		1		41	22	1	1	32		4	102
	2	7		4	18	9	4	7	5	4	32	90
	3		5		2	2	5	7	3	40	15	79
	4	17	2			28		3	8		44	102
	5	16	3		24		2	6	24		4	79
	6	4	2	2	7	5		38	51		16	125
	7	10	10	14	11	29	30		46		40	190
	8	76	5		29	65	9	12		1	7	204
	9		5	34	2		4	2	2		9	58
	0	12	30	3	255	37	1	15	32	6		391
Total		142	63	57	389	197	91	91	203	51	171	1491

Table XIII.—Distribution of the kinds of errors made by the 500 selected children. (For further explanation, see corresponding table for backward class children, page 20.)

One important conclusion is to be drawn from the data as

arranged in table XIV, analogous to table VII (page 21). Here the twelve most frequent errors as shown in table XIII, are arranged according to ages of children. In the upper horizontal line are the frequencies of each of these twelve errors made by five year olds and in the other horizontal lines they are shown

Ages	Kinds of errors											
	0-4	8-1	8-5	6-8	7-8	4-0	1-4	3-9	7-0	6-7	0-5	9-3
5	12	3	6	2	3	3	2	2	2	3	2	3
6	10	3	3	2	1	4	2	5	3	4	2	4
7	20	2	5	2		4	4	2	1	1	1	4
8	21	6	5	5	5		1	2	2	5	2	1
9	17	5	2	4	3	3	2	2	3	1	3	2
10	14	7	4	6	4	2	1	1	2	2	3	1
11	16	11	4	3	3	3	3	2	3	1	3	
12	21	5	3	2	5	3	2	2	5	2	1	
13	15	4	1	3	4	1	5	6	1	1	2	1
14	13	4	3	2	1	2	3	5	3	2	2	1
Average	16	5	4	3	3	2	2	2	2	2	2	2

TABLE XIV.—The twelve most frequent kinds of errors of the 500 selected children arranged according to ages. (Compare with table VII, page 21.)

for children of other ages. The most important fact revealed is that certain kinds of errors are favored by children of all ages. The occurrence of the 0-4 error varies little with age and the others are evenly distributed. As has already been stated the errors by older children are due chiefly to hurrying. They can discriminate these forms with certainty when not hurried, but if they get only a glimpse of the block form and have little time for imaging it and comparing it with the recess forms, they make the same errors as the younger children. The blurred perception of the older children and the faulty perception of the younger ones give the same results.

It has been stated by some who use the form board test that if a child persists in making the same kind of errors he is lacking in learning ability. This seems plausible on the assumption that he ought to recognize the situation and not repeat the same errors. But it is not borne out by results. On the contrary it is shown that bright children as well as dull ones often persist in the same

kind of errors and that most of the extremely backward show no tendency to do so. The following record of a bright nine year old boy is a conspicuous case of repeating particular errors. In this case the two errors 2-8 and 4-0 were each repeated and they might have appeared in all three trials had not the order in which the blocks were piled made it impossible. The number of normal children out of the 50 of each age who repeated one or more errors was as follows:

FIRST TRIAL	SECOND TRIAL	THIRD TRIAL
3	5	7
1	282	5
5	7	8
8	1	2
6	404	404
2802	0	6
9	9	3
0	3	1
7	8	0
4	6	9
26 sec.	23 sec.	19 sec.

Age	5	6	7	8	9	10	11	12	13	14
Number who repeated errors	14	14	12	8	14	7	9	11	4	7

There is a type of defectives who persists to an extreme degree in repeating errors or in trying to put every block picked up into a certain recess. The records of the 605 backward class children show a dozen such individuals, but the great mass of the backward class children repeated errors less often than did the normal children.[8]

Summary

This study of the 500 selected children may be summarized as follows:

Children vary so widely in their development and advancement that in order to reveal their changes in any capacity from year to year, a large mass of data would be necessary. The collecting of this is impracticable for a test requiring the time that the form board does. The difficulty was partly handled by collecting a reasonably large amount of data from carefully selected homogeneous groups.

[8] No exact comparison is possible. 161 of the 605, as compared with 99 of the selected 500 normal children repeated errors, but since their total number of errors of all kinds was more than twice the number made by the normal children the chances for repeating were far more than enough to make up for the larger number who did repeat. Also there were 105 more individuals in the group.

Four possible indices for representing a child's form board ability were considered; the time records for the first trial, for the third trial, for the shortest of three trials, and for the average of three trials. The first trial index was eliminated because of its wide and irregular variability. The third trial index proved to be unreliable because bright children often fall back badly on the third trial through over-hurrying, change of method of handling the blocks, or bad luck in fitting them into the recesses. The shortest of three trials index has the lowest variability of the four and is almost as regular by ages as any other, so from the statistical point of view it is the most reliable. When applied to individual children it failed in many cases to agree with the results from careful mental examinations. The average of three trials index was next tried. It proved more satisfactory in its application to individual cases, evidently because it gives weight to the first trial, a feature not embraced by the variability criterion. The outcome was a modified method of giving the test and of treating the data. Since this new method involved a change in the testing procedure it could not be applied in every way to the data from the 500 selected children. Fortunately the important results from which the data had been taken are the same, no matter what standard index is used. The following conclusions therefore apply to the new method and to all others in which the time element is made the main feature.

1. There is a negative correlation between age and the time required for placing the blocks.

2. Five year olds show an extremely wide individual variability and on the average their time records are comparatively long. Because nearly all work so slowly, their number of errors is lower than would be expected, judging from the number made by other age groups. A few six year olds work slowly like five year olds, but the differences between ages five and six are much greater than the differences between ages six and seven. There are unexplained irregularities in the records of nine year olds. After the age of twelve there is practically no gain in form board ability except that due to better planning and to greater

effort. As a result thirteen year olds and fourteen year olds make shorter time records but the extra hurrying causes them to make more errors than the twelve year olds.

3. Excepting that for five year olds, averages of time records for each age should be quite reliable as standards with which to compare individuals.

4. Sex differences in the form board test are negligible.

5. The 0-4 error is much the most frequent but there are others that are favored. Block 0 is the most often misplaced and block 9 the least often. These facts are equally true for children of all ages.

6. A tendency to repeat certain kinds of errors is not indicative of weak mentality unless persisted in to an extreme degree.

V

A STANDARDIZATION OF THE FORM BOARD TEST

There is a general tendency at present to over emphasize mental tests. Many of the uninitiated expect tests of mentality to be as decisive and as reliable as the acid test, and some experienced examiners are quite dependent on them. They fail to realize fully that mind is a *function,* and that it is the resultant of a complex of factors which no one test can even approximately measure. Co-ordinated systems of tests such as the Binet-Simon cover a number of the factors, but no team of tests has as yet been offered which comes near covering all. The investigator believes that for a single test the form board is unexcelled; that an examiner who is cognizant of the limitations of tests and who knows how to articulate their results with his judgment based on general observation of the child, will find in this test a most valuable and reliable aid. It is from this viewpoint that the following standardization is given. In the preceding studies conclusions were reached on most of the important features of the form board test and a satisfactory method of using it and of interpreting its results were worked out. The various features of this method have been described only in connection with the studies through which they were evolved, so at the beginning the following complete statement is necessary.

The Method of Applying the Form Board Test

The form board lies horizontally on a table, its lower edge even with the edge of the table next to which the child stands. The table must be low enough to allow him to lean well over the board and to look down upon its center. The blocks are placed in three piles on the table next to the upper edge of the board, no block in the pile nearest its recess, the lozenge and the elongated hexagon not in the same layer, and the star in the lower layer. This is the arrangement at the beginning of each of

three trials. The child is introduced to the test with no instruction concerning it except, "Let us see how quickly you can put the blocks into place." His first reactions and his behavior until he succeeds in getting the blocks into place or fails are carefully studied. After this first trial he is given any instruction necessary to make him understand where the blocks belong and that he is to replace them as quickly as possible. Then he is given a second and a third trial, in which he is encouraged and urged in every way to make the best record of which he is capable. These last two trials are timed with a stop watch and the shortest of the two records is taken as the child's form board index. In addition the examiner records an estimate of the child's co-ordination and poise;[1] of whether he plans ahead; of whether he successfully uses both hands at the same time; and after the test is completed he dictates to his assistant his observations of individual features. During the testing the assistant has taken a complete record of the order in which the blocks were handled.[2]

The record of the test then consists of four parts;—(1) An account of the first trial. (2) The shorter of the two time records. (3) A record of co-ordination, poise, planning ahead, use of the hands, and general observations. (4) A record of the handling of the blocks. This is not so cumbersome as it looks. All of it is taken while the child is at work, except part of the account of the first trial and the general notes, and these unless the case is an unusual one are stated in a few words.

The Standardization

This work was undertaken through the testing of another group of public school children. The results from the 500 selected children reported in the previous section could not be used because in those tests careful instruction was given before the first trial instead of before the second trial as in the method finally adopted. Also, in order to make the group as nearly homogeneous as possible, they had been selected according to

[1] For meaning of these qualities as used here see p. 19.
[2] For method see p. 14.

requirements which made them above the average of ordinary children. Therefore new data had to be collected. It was proposed to test 250 of each of the ten ages, 2500 in all, but this was found to be too large an undertaking. Inasmuch as the five, thirteen, and fourteen year standards would be of less value than the others,[3] it was decided to include fewer of these ages and to spend the available time on the ages for which the standardization would be of the most value. In all 1537 children were tested. Except that no especially backward or peculiar children were included there was no selecting. The results arranged according to the four parts of the records are as follows:

(1) No attempt was made to standardize the features that are to be observed in the first of the three trials. The examiner is not limited as to what he shall look for in this part of the test. He must have his whole stock of psychological knowledge open for apperceiving whatever is brought out, so the features that strike him as important may vary widely in different children.

(2) The age distribution of the time records is shown in table XV. Corresponding closely to this is table X, page 29. The latter displays a much more restricted distribution because the 500 children were selected with the purpose of securing homogeneity, but the age variability of the time records is much the same in the two tables. Averages of the time records for each age, and their limiting zones are given in table XVI[4] and

[3] See pages 8, 36, and 38 for reasons.

[4] In the following table these time averages are compared with those which Goddard obtained by a somewhat different method from 250 children. (Training School, IX, 51.)

AGE	GODDARD'S AVERAGES	AVERAGES FROM THE PRESENT INVESTIGATION
5	29.5	37.6
6	27.5	26.5
7	24.5	23.3
8	21.8	20.6
9	19.3	18.6
10	18.2	16.7
11	17.6	14.9
12	15.9	13.8

Time in seconds.	5	6	7	8	9	10	11	12	13	14
75	1									
58	1									
57										
56	3									
55	1									
54										
53	1									
52										
51										
50	2									
49	1									
48	1									
47	1									
46	1									
45	2									
44	2									
43	4									
42	5									
41	2	2								
40	2	1								
39	3	1								
38	6	1	1							
37	2	3								
36	1	1	1							
35	6	3								
34	5	6	1		1					
33	3	3	3							
32	3	9		2						
31		11	2	1	3					
30	2	10	4	3	1					
29	4	5	6	2	3					
28	3	11	5	5	2					
27	1	9	13	2	2	1				
26	5	11	16	6	4	2				
25	1	14	7	6	4					
24	2	21	17	4	3	6	1			
23	2	6	13	12	6	4		1		
22	1	7	18	18	10	2	2			
21		12	24	28	8	9	1	1		
20		11	13	39	19	11	2	2		
19		6	8	19	19	22	4	1		
18		6	10	13	31	16	7	2		
17			5	20	29	28	17	9	2	1
16			5	16	26	28	26	8	5	2
15			1	8	30	38	39	22	6	4
14				2	9	24	29	31	11	6
13					4	17	19	20	11	9
12						13	17	21	23	16
11							4	17	15	16
10							2	6	3	18
9							2		4	8
	5	6	7	8	9	10	11	12	13	14
					Age.					

TABLE XV.—Distribution of the time records of the 1537 normal children.

Ages	Number of cases	Average time	Zone limits	Standard deviation
5	80	37.6	22-75	9.66
6	170	26.5	18-44	5.23
7	173	23.3	15-38	4.14
8	206	20.5	14-32	3.59
9	214	18.7	13-34	3.88
10	221	16.7	12-27	3.06
11	172	14.9	9-24	2.32
12	141	13.8	10-22	2.29
13	80	12.6	9-17	1.85
14	80	11.6	9-17	1.85

TABLE XVI.—Time records of the 1537 normal children.

in chart IV. In the chart the heavy line represents averages of time records and the shaded portion includes the 1537 records. For example the average time required for eight year olds to place the blocks is shown to be 20.6 seconds, while the shortest and the longest records for that age are 14 seconds and 32 seconds respectively. Table XV shows that in most cases the records are well enough distributed over the zones to make the zone widths a rough expression of the variability at each age. In chart IV we have a complete standardization of the time features of the form board test. By referring to it one can quickly interpret the time record of a child. Unless his record falls outside the zone limits for his age he is to be considered normal in this important feature of the test, but of course the nearer it comes to the line of averages the better. It would be presuming too much to claim that these zones definitely divide the normal from the sub-normal, but in order that the line of averages may be of the most value the zone width at the different ages must be considered with it. For instance it is shown that a seven year old child's record may be considerably farther above the line of averages than could be allowed in a ten year old's record without suspecting sub-normality. Attempts to produce a better chart than this by displaying the standard deviations instead of the distribution limits have failed. It is possible in that way to give more regular zone boundaries than are seen in this chart, but there is no basis for reducing them to a scale that would satis-

factorily represent standard deviations in connection with the line of averages. In fact the chart as given comes remarkably

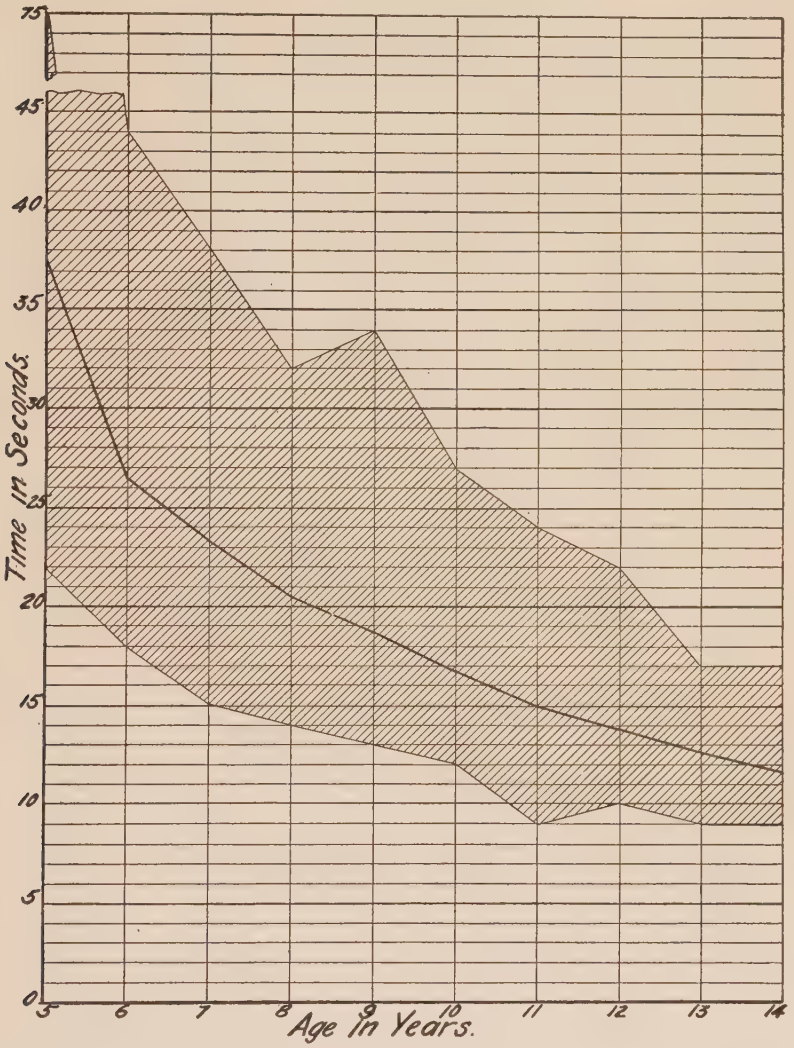


CHART IV.—*THE FORM BOARD TIME CHART.* The heavy middle line shows the average time record for each age, and the shaded zone is limited by the shortest and the longest records for each age.

near to presenting the standard deviations. It happens that by multiplying the standard deviations by 5 they can be compared

with the zone widths. This is shown in the accompanying table:

Age	5	6	7	8	9	10	11	12	13	14
Width of time zone	53	26	23	18	19	15	13	12	8	8
5 S. D.	49	26	24	19	18	16	12	12	10	10

This approximation of an index of variability by the zone widths adds greatly to their reliability. The two or three serious irregularities in the zone boundaries are objectionable, but they have a value in constantly reminding the user of the chart that records falling near the zone limits are of uncertain interpretation.

(3) To establish standards on poise and co-ordination it would be necessary to grade a large number of children who are defective in these features. Nothing in that direction was attempted in this study. None of these 1537 normal children were seriously lacking in either. Of the 605 backward class children, every individual who was given a low grading in one of these features proved to have other defects and to be mentally subnormal. Hence the conclusion is to be drawn that serious lack in co-ordination or poise indicates mental deficiency.

Data were taken as to how many of the 1537 children planned ahead. The results stated in per cent. of each age group follow:

Age	5	6	7	8	9	10	11	12	13	14
Per cent. planning ahead	0	0	0	4	9	10	16	26	50	54

Obviously a child should be given considerable credit for planning ahead since very few younger normal children and only 8 per cent of the backward children do so,[5] while about half of the older normal ones do.

A record was also taken of the number who used the two hands at the same time successfully. The following statement is in per cent. of each age group:

Age	5	6	7	8	9	10	11	12	13	14
Per cent. using both hands	0	8	14	38	45	54	64	88	100	98

Here again the older children succeed best, but ability to use both hands at the same time successfully is not confined to children of quite so high advancement as is planning ahead. Nearly all of

[5] Table V, page 17.

the older children and 26 per cent. of the backward class children succeeded in using both hands.[6]

(4) The record of the handling of the blocks is taken in such a form as to need no simplification or reduction to an index. The masses of digits display to the best advantage the number of errors and the improvement and other variations in the placing of the blocks. No standards of the number of errors made by normal children of various ages could be established because normal children make comparatively few errors and their average number shows no consistent correlation with age.[7] Defectives, on the contrary, make numerous errors, and for purposes of comparison the following general statement drawn from table XVII

Number of errors.	5	6	7	8	9	10	11	12	13	14
32	1									
21	1									
20										
19										
18										
17										
16			1							
15		1			1					
14		1			1					
13		1		1						
12	1		1		1					
11			3			1				
10	1	5		1						
9	2	3	1	1	2	1	1			
8	1			4	1	2			2	
7	2	3	3		3	3	2			1
6	1	4	6	2	4	1	2	2	1	2
5	5	2	2	7	2	3			2	5
4	14	2	5	2	7	5		1	4	5
3	9	9	10	7	6	8	5	4	8	11
2	6	6	3	10	10	11	12	16	9	7
1	3	12	14	7	6	8	15	11	11	8
0	3	1	1	8	6	7	13	16	13	11
Age.	5	6	7	8	9	10	11	12	13	14

TABLE XVII.—Distribution of the 500 selected children according to the number of errors made in three trials. (These results instead of those from the 1537 children are used because their age groups have equal numbers of individuals, 50 each. This makes them more suitable for a display of frequencies.)

[6] Table V, page 17.
[7] Chart III, page 36.

is of value. Some children of all ages make no errors and the majority make less than four in the three trials at the test. A few of each age make as high as ten, an occasional one younger than ten years makes as many as twenty, while a few five year olds make more than twenty.

It has been worked out in previous studies[8] that attempts to place the lozenge block in the elongated hexagon recess is by far the most common error, and that certain other kinds of errors, especially those involving the flattened oval, are made quite frequently. Extremely backward children find all forms equally difficult, making as many errors of one kind as of another. So a tendency to favor these common errors is creditable to the child, many bright children repeating from one to three errors in the three trials,[9] but an extreme tendency to repeat an error, especially attempts to fit every block into some one recess, indicates quite low mentality.

This completes the standardization of the form board test for children between five and fourteen years of age. Of the four parts of the record, the time index is the most important because it is convenient for use in speaking of a child's form board ability and because it usually includes what is shown in the others. By this is meant that if a child makes many errors or lacks poise or is lacking in any other feature, his time record will be accordingly longer. The occasional cases in which a time index alone is misleading make it necessary to record the other features, and since this can be easily done it is best to make a full record in every case.

[8] Pages 21 and 40.
[9] Page 41.

APPENDIX

CHILDREN UNDER FIVE YEARS OF AGE

A group of thirty-five four year old children were given the form board test, the regular method being used except that the child was handed each block and in case he spent considerable time trying to fit it into a wrong recess he was told to try another. All normal four year olds can place the blocks if given that much help. The shortest time record was 20 seconds, the longest 91 seconds, and the average 46 seconds. Three of the thirty-five made no errors, one made 42, and the average number made was 11. Seventeen made their best record on the second trial and eighteen on their third. Because they were handed the blocks and were not allowed to spend too much time trying a wrong recess, the effects of fatigue are not so noticeable in the time records, but the majority showed waning of interest and fatigue on the last trial.

Nine children between three and three and a half years of age were tested in the same way except that they were given but two trials. Their shortest time record was 49 seconds, the longest 113 seconds, and the average 69 seconds. The number of errors varied between 12 and 24, the average being 16. Six of the nine did better on the second trial than on the first.

Seven children between the ages of two years three months and two years six months, with considerable help gave time records ranging from 52 seconds to 148 seconds and an average of 92 seconds. Their errors ranged between 4 and 25 for the two trials, with an average of 17. Four did much better on the first trial than on the second. All of these children perceived the relation of block form to recess form for at least the circle and the square. They commonly confused the cross with the star, the oval with the semi-circle and the circle, and the triangle, the lozenge, and the elongated hexagon with each other. If they happened to get the lozenge crosswise over its recess, they usually would not turn it without help. They often searched in the piles for a block for some particular recess or picked up the circle in preference to others. Some tired of the test after a trial or two but two cried because they were not allowed to continue.

The test was tried on several children between one and a half

and two years of age. The form board was laid on the floor. With much help one child placed six blocks and others placed two or three. Some showed unmistakeably that they perceived the circle form and certain of the other more simple ones. The majority piled the blocks one upon another instead of attempting to fit them into recesses. At the Philadelphia Infants' Home, a form board was left in one of the rooms where a dozen of these little tots spent most of the day, and their nurse attempted for a week to teach them to put the blocks into place. Some made a little progress but all continued to pile them and not one learned to complete the test.

ADULTS

Adults place the blocks a little more quickly than do fourteen year olds. Most of their records fall between 9 and 12 seconds. An occasional 8 second record is made, and three individuals out of more than a hundred made records of 7 seconds in one of their first three trials. Practically all adults plan ahead. The most successful handling of the blocks is a rhythmic alternating of the two hands, one hand fitting a block while the other is picking one from the piles. When one attempts to fit two blocks into their recesses simultaneously time is lost, probably because of the attempt to divide the attention.

CHILDREN OF LOW MENTALITY

There is no kind of reaction to the form board test that is strictly typical of any one grade or class of defectives. This is partly due to the fact that each of our standard classifications has its own basis, such as industrial capacity, linguistic ability and educability. Accordingly children may rank quite differently under different classification systems, and the form board test could not be expected to label individuals directly for their place in a mental scale unless such scale had form board ability as its basis.[1] For diagnostic purposes it is therefore necessary first to compare the individual's form board reaction with the reaction of normal children, and then after he has thus been approximately placed, to study his reaction in comparison with that of other defectives. Hence the importance of normal standards.

[1] Form board time records do not correlate well with Binet Test results, children who are considerably retarded according to the Binet scale usually being more successful at the form board test than are normal children of the corresponding Binet age.

All kinds of mental defectives who can do anything with the form board were included among the 605 backward class children whose tests are reported in Section III of this monograph. But since that study was made before the standards for normal children were established, it is worth while to supplement it with the following notes on tests of defectives made after the work on normal children had been completed.

Seventy-six imbeciles and idiots ranging in age from nine to seventeen were given the form board test,—some in the Psychological Clinic of the University of Pennsylvania, some in the Pennsylvania Training School for Feeble Minded Children at Elwyn, and some in small private schools. As to the time records, the records of errors, and the records of other items that are included in the standards given in the last section of this monograph, these later observations of defectives seem wherever possible to corroborate the conclusions drawn there. They show nothing that disagrees with those conclusions. Of the seventy-six defectives, forty-two succeeded in putting the blocks into place three times, fourteen placed them once but not three times, and twenty failed to place all of them even once. Of those who placed them one or more times, thirty-three required more than 30 seconds for the shortest trial. There were several times as many errors as would have been made by normal children, and there was only an irregular tendency to favor the 0-4 error. Very few attempted to use both hands at the same time and but nine did so successfully. None planned ahead. A large number were lacking in poise; some being confused by their own efforts as well as by the urging and assistance offered by the examiner. In some cases the confusion was only temporary, poise being regained and the work proceeding successfully for a time, but in others even after a promising beginning, control was lost and the efforts ended in utter confusion. Some of these defectives are at an opposite extreme from those who lack poise, being abnormally inert and stolid. They work at the form board in a listless, indifferent manner, lacking either the inclination or the ability to start quickly and to work rapidly. The most of these make somewhat better records when urged strenuously. A normal child is alert but at the same time has self-control and poise.

There is no testing device that makes a stronger appeal to the interest of children, both normal and defective, than does the form board test. It is therefore a good test of attention. Practically every child gives it the best attention of which he is capable. Twenty-four of the seventy-six defectives gave the test

undivided attention as long as the examiner wished them to work at it, although some of them worked slowly and made many errors. Fourteen gave good attention through one trial but wandered from the task before told to stop. Thirty-one showed various degrees of flightiness, some attending to the test but a few seconds at a time, and others almost completing a trial. Some of these returned to it of their own accord, others had to be reminded by the examiner. Three of them refused to return to it. Seven could not be interested in the test at all, and made no effort to place blocks. Fatigue is a factor in the case of many who lose interest.

The emotional reaction of defectives to the form board test is extremely interesting. Affectively, only ten of these seventy-six reacted like normal children. Seventeen were apathetic, the test arousing little or no interest in them. Thirty-three found great enjoyment in it, working enthusiastically, some talking and chattering while at work and many of them expressing extreme joy when a block or blocks were placed successfully. It was probably the most difficult piece of work that some of them had ever done, hence their feeling of triumph and satisfaction in succeeding. Some of the more excitable ones would of course react in the same way to any test involving activity. The other sixteen gave various kinds of curious and inconsistent reactions. One large boy started well but before half of the blocks were placed he began to weep hysterically and ran away refusing even to look backward. Several others wept and wailed, attracted to the test but forced to leave it because of embarassment and excitement.

These notes give but a glimpse of what can be observed in form board tests of defectives. For instance the attempt to group the seventy-six cases on the basis of attention might be extended to include an analysis of each individual's volitional complex. It would cover not only his power of attention, but also his initiative, his self control, and the intensity of his effort. A full report would include the painting of a clinical picture of each case. How much of this is profitable depends on the individual case and on the extent to which other tests and means of analysis are employed. These notes are suggestive of what may be worked out from the form board test, and they emphasize the fact that *normal* standards must be the basis upon which each defective's reaction to the form board test is to be interpreted.